Regulation and Corporate Corruption:

New Evidence from the Telecom Sector[1]

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Abstract

This paper examines how government regulation in developing countries affects the form of corruption between business customers and service providers in the telecom sector. We match the World Bank enterprise-level data on bribes with a unique cross-country telecom regulation dataset collected by Wallsten et al. (2004), finding that (1) strong regulatory substance (the content of regulation) and regulatory governance reduce corruption; (2) competition and privatization reduces corruption; (3) the effects of regulatory substance on corruption control are stronger in countries with state-owned or partially state-owned telecoms, greater competition, and higher telecommunication fees; and (4) bureaucratic quality exert substitution effects to regulatory substance in deterring corruption. Overall, our results suggest that regulatory strategies that reduce information asymmetry and increase accountability tend to reduce illegal side-payments for connections.

Keywords: Telecommunications, Regulation, Corruption

JEL classification: Illegal behavior, K4; Regulation and industrial policy, L5; Industry studies, L9

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1. Introduction

The telecommunications industry has become one of the fastest-growing industries in many developing countries. It is also believed to provide substantial positive externalities to other businesses (Li and Xu, 2002). Röller and Waverman (2001) find that a country's economic growth is positively related to its telecommunications infrastructure. However, corporate corruption, among many challenges facing public service institutions by developing countries, is one of the most pervasive and difficult ones to deal with.

There is already a substantial literature on the determinants of corruption;[2] regulation is considered as an important factor that affects corruption (Stigler, 1971; Peltzman, 1976; Laffont and Tirole, 1991, 1993; Djankov, La Porta, López-de-Silanes, and Shleifer, 2002). However, in the telecommunications industry, corruption can take place in various forms, such as between telecommunications service providers and politicians, between telecom companies and the regulator, between telecom companies and companies from other sectors who want to obtain better services, and between service providers and service users (where the latter need to pay side-payments to get connected. Therefore, the effects of regulatory control on corruption may be different across different forms of corruption. For example, a regulator may have efficient control on service providers by controlling demand for bribes from customers; however, meanwhile service providers could use bribes to build up political ties in order to secure their profits despite the presence of a strict regulatory agency. In the former case, more regulation control is correlated with less corruption at the regulated firm level, but in the

[2] See, for example, Treisman (2000), Svensson, (2003), Clarke and Xu (2004), Aidt, Dutta, and Sena (2008), Beck, Demirgüç-Kunt and Levine (2006), Fan, Lin, and Treisman (2009), Barth, Lin, Lin, and Song (2009) and Anbarci, Escaleras, and Register (2009). In addition, Dreher, Kotsogiannis, and McCorriston (2006) employ a structural model by treating corruption as a latent variable to derive an index of corruption.

latter case, more regulation control could be correlated with more corruption at the political level. Recent work done by Estache and Wren-Lewis (2011) reviews the theories of corruption in regulated sectors and explains the many forms of corruption in sector governance and regulation. However, due to the complex relationships in the governance of telecommunications industry and associated data limitations for conducting studies,[3] there are still gaps in our empirical knowledge of these issues – to date, the impacts of government control on corporate corruption have rarely been empirically tested. In this paper, we aim to fill some gaps in the existing literature by focusing on whether the regulator as the third party can effectively limit the side-payments between telephone services providers and business customers.

Certainly, a well-designed regulatory system can enhance corporate governance of regulated firms (Beck, Demirgüç-Kunt and Levine, 2006) and reduce their misconduct (such as fraud and requiring connection side-payments from their customers. If the government can create a countervailing institution which has the power to deter corruption and enforce penalties, regulatory control should be associated with less connection-facilitation payments. This outcome occurs because efficient regulatory control can provide credible threats to those service providers whose managers or installation staff request facilitation payments; at the same time, transparency promotes bargaining power for customers. Nonetheless, strong regulation may not necessarily reduce the demand for bribes because of the difficulty and complexity of combating this form of corruption. Especially in emerging countries, resource allocation is often shaped by political connection. Regulators with strong oversight powers may use their power to

[3] Only a few studies have been performed, and these provide mixed evidence. For example, Djankov et al. (2002) find that countries with heavier regulation of entry (involving more procedures, costs, and delays in obtaining permission for entry) are associated with higher corruption levels. Beck et al. (2006) find that more supervisory power induces more corruption in bank lending while supervisory strategies that focus on forcing accurate information disclosure help reduce corruption in bank lending. Seim and Soreide (2009) find that corruption, when coupled with regulatory complexity, negatively affects performance in infrastructure sectors, including telecommunications. However, they use a general corruption index from the World Bank governance indicators, while we utilize micro-data from individual business users of telecommunications services - allowing more rigorous tests of the impacts of corruption.

induce noncompliant firms to divert resources to companies with political ties (Beck, Demirgüç-Kunt and Levine, 2006; Emerson, 2006; Houston, Lin and Ma, 2011). In such cases, the revenue sharing between politicians and utility companies may be catalysts for side-payments demand. As a result, it is important to know whether and to what extent regulatory control is efficient enough to control telecommunications connection-facilitation payments.

To answer these questions, we examine two aspects of government regulation in this paper: *regulatory governance* and *regulatory substance*. Previous research usually focused on regulatory governance, which can be characterized by four elements: independence of the regulator, clarity of responsibility, accountability, and transparency and participation (Stern and Holder, 1999; Gutièrrez, 2003). The present study also considers regulatory substance indicators: standardized regulatory tariff setting, quality of service standards, sufficient (but not excessive) accounting professionals, and periodic review procedures. Regulatory governance refers to the institutional and legal design of the regulatory system and the creation of the regulatory framework within which decisions are made. Regulatory substance refers to the actual decisions made by the regulator.[4] The difference between regulatory substance and regulatory governance is that the former is the "what of regulation" and the latter is the "how of regulation."[5]

Including a variable for regulatory substance is important for analyzing the control of corruption because this variable captures the extent to which the regulator is able to establish a reasonable tariff level and has compliance procedures for a minimum service standard. Detailed standards leave less leeway for service providers to exercise discretion towards their customers. In addition, regulatory substance also indicates whether the regulatory agency has enough auditing resources for monitoring performance and is in a

[4] Levy and Spiller (1994, 1996) use the term "regulatory incentives" to denote "substance."

[5] Executive Summary, *Handbook for Evaluating Infrastructure Regulatory Systems*, 2006, Ashley C. Brown, Jon Stern, and Bernard Tenenbaum with Defne Gencer, the World Bank, Washington, D.C., p.5

position to conduct investigations necessary for evaluating previous decisions. All these features are important if the regulator is to deter corruption. Therefore, we expect that strong regulatory substance is associated with less facilitation payments in the sector.

Our two measures of the regulatory system capture the actual operating procedures of regulatory agencies, distinguishing our research from previous empirical studies that focus solely on elements of regulatory governance. To our knowledge, this paper is the first one to quantify regulatory substance to test the effects of government regulation on perceived corporate corruption in the telecom sector.[6]

Our analysis uses the World Bank datasets (WBES and EECAS) that contain enterprise-level data on bribes paid to telecom utilities and a unique cross-country telecom regulation dataset collected by Wallsten et al. (2004). Based on a sample of 3,731 firms in 26 transitional economies, we find strong evidence that both regulatory substance and regulatory governance reduce corporate corruption. We find competition reduces corruption and along another industry feature, state-owned telecoms are associated with more corruption. Furthermore, the effects of regulatory substance on corruption reduction are more pronounced in countries with more competition, less privatization and higher telecom fees. Our results suggest that regulatory strategies that reduce information asymmetry and increase accountability tend to reduce corruption.

Our study makes several contributions to the existing research. First, there is substantial literature on corruption in the public utility sector (e.g. Clarke and Xu, 2004; Dal Bó and Rossi, 2007; Vagliasindi, 2011);[7] we extend previous studies by providing

[6] We use *corporate corruption* thereafter to refer to the particular form of corruption we examined in the paper, i.e., bribery and side-payments activities by private enterprises to telecom service providers; in some developing countries, telecommunications service is still owned or partially owned by the government, which we examine here. However, the main goal of this paper is to determine whether the regulator as the third party can effectively limit corruption between business customers and service providers. For example, Kenny (2009) argues that a separate "anticorruption agenda" in infrastructure reform may be misplaced: a broader agenda of improved governance simultaneously targets a wider range of issues (including transparency, professionalism, and citizen participation).

[7] Clarke and Xu (2004) study how privatization and competition affect corruption in the telecom and electricity sector of developing countries. They find that increased competition, more expansive private ownership, and less stringent capacity constraints are associated with reduced corruption. Dal Bó and Rossi (2007) study 80 electricity firms from 13 Latin American countries and find that corruption in those countries is strongly associated with inefficiency within the industry. Vagliasindi (2011) uses case studies to compare performance between private and

empirical evidence of how government regulation helps to curtail facilitation payments between customers and service providers during the process of regulatory reform. This is an important point because the weak sector performance that results from this type of corporate corruption not only limits access to telephony, hinders utility reforms, but also constrains private business growth and development (Estache, Goicoechea, and Trujillo, 2009). Second, our study contributes to the literature on the micro-based incentive study on firm corrupt behavior in emerging countries (Svensson, 2003; Clarke and Xu, 2004; Cai, Fang and Xu, 2011). Third, we provide a quantitative study that complements the regulation literature examining the impacts of regulatory schemes on firm operations. Previous studies find that regulatory schemes affect service quality (e.g. Ai and Sappington, 2005), operating efficiency (e.g. Li and Xu, 2004; Berg, Lin and Tsaplin, 2005), and the provision of public goods (Bose, Capasso, and Murshid, 2008). We add to the existing literature by showing that regulatory schemes have significant effects on reducing the form of corruption that is associated with obtaining access to service.

The remainder of the paper is organized as follows. The next section presents data and summary statistics. Section 3 presents empirical methodology and results. Section 4 discusses robustness checks. Section 5 provides some concluding observations.

2. Data

Our data come from three main sources: (1) the World Business Environment Survey (WBES)[8] in 1999-2000 and the Eastern Europe & Central Asia Survey (EECAS) in 2001 by the World Bank for firm-level data on bribery frequencies, and a set of firm-specific characteristics;[9] (2) Wallsten et al. (2004) for country-level data on regulation

public utilities within water, electricity and rail sectors, suggesting that state-owned utilities are the prime candidates for potential corruption.

[8] It is also called "Measuring Conditions for Business Operation and Growth" Private Enterprise Questionnaire in 1999.

[9] Note that we do not use the updated WBES survey data for 2005 published on the World Bank website because so far there has been only one cross-country regulation survey conducted among telecom regulators since 2001. This is

from their survey conducted in 2001; and (3) World Telecommunication Regulatory Database published annually on the International Telecommunication Union (ITU) website for country-level data on privatization and competition, and the ITU Statistical Year Book 2002 for tariff-level data. We also collect macro country data from the IMF website, the World Bank website and country-level data on governance from the World Bank's Worldwide Government Indicators (WGI) project by Kaufmann, Kraay, and Mastruzzi (2006). While the combined WBES database and the EECAS data contain over 80 countries, the Wallsten et al. (2004) regulation dataset includes data on only 45 countries. The limited overlap of these three datasets reduces the sample to 3,731 firms from 26 countries.[10]

In our sample, 35% of the firms are small firms (less than 10 employees), 10% are medium-sized (between 11 and 500 employees), and the remaining 55% are large firms (more than 500 employees). Most of the firms in the sample are from manufacturing (36%), service (45%), construction (10%), or agriculture (5%) sectors. To examine the relationship between regulation and bribery extracted from their business customers by managers of regulated firms (or their installation personnel), we employ firm-level data. We also control for a range of firm-specific and country-specific characteristics.

2.1. Dependent Variable: Corruption

The dependent variable, *Corruption*, is constructed based on the answers to the question "Do firms like yours typically need to make extra, unofficial payments to service providers to get connected to telephone?" in the WBES and EECAS surveys.[11] The answers to this question captures the frequency of bribery, including "never,"

about the same time as the WBES survey in 1999-2000. Also, since early 1990s, an increasing number of developing countries started their regulatory reforms, which provides an ideal opportunity to identify variations in regulatory policies across countries.

[10] We exclude countries that have less than 10 firm observations.

[11] The EECAS survey is conducted by the World Bank, which uses essentially the same questionnaire, and contains more Eastern European and Central Asian firms.

"seldom," "sometimes," "frequently," "mostly" and "always" in the survey.[12] To reduce the possibility of idiosyncratic firm responses, we code the answers as "1=never, 2=seldom, sometimes, frequently, or mostly and 3=always."[13] Overall, 62.2% of the firms in the sample report that they never make extra, unofficial payments to public officials to get connected to telephone, 5.2% of firms report that they always pay unofficial payments to the service providers, the rest of firms report they pay bribes with frequencies from seldom to mostly. The average frequencies of bribes for each country are shown in Table 1 (column 3). We compare the calculated aggregate frequencies of bribes with the Transparency International Global Corruption Perception Index (GCPI) in Figure 1. Since the GCPI ranges between 1 and 6, with higher value indicating less corruption and our frequencies of bribes are measured with higher value indicating more corruption, we find a negative correlation between these two indexes, suggesting that our measure of country level corruption is consistent with Transparency International. We calculate the overall standard deviation of the *Corruption* variable, which is 0.59, and the between-country standard deviation and within-country standard deviation, which are 0.32 and 0.50, respectively.[14] Since the mean of *Corruption* is 1.43, the differences in standard deviations imply that the frequencies of bribes vary not only across countries but also across firms within countries.

[12] We dropped those firms that do not answer this question or respond "I don't know."

[13] In our previous version of working paper, we have coded the answers as "1 = never, 2 = seldom, 3 = sometimes, 4 = frequently, 5 = mostly and 6 = always," and all the empirical results are consistent with the current ones.

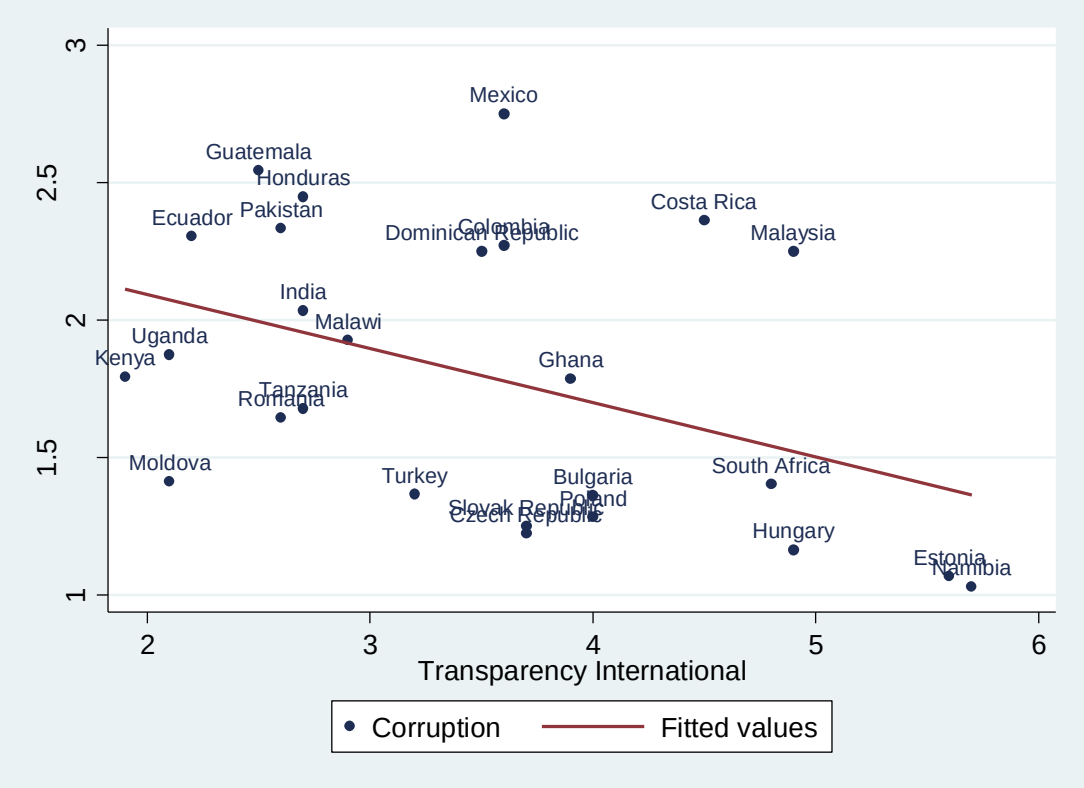
[14] The between-country standard deviation is calculated from the country averages; the within country standard deviation is calculated using the deviations from country averages.

Table 1. Country List, Corruption Indexes and Regulation Indexes

Country	Region	WBES Corruption	Transparency International	Regulatory Substance	Regulatory Governance
Bulgaria	Europe	1.36	4	0.43	0.80
Colombia	South America	2.27	3.6	0.05	-
Costa Rica	Central America	2.36	4.5	0.01	-
Czech Republic	Europe	1.22	3.7	0.70	0.74
Dominican Republic	Central America	2.25	3.5	0.07	-
Ecuador	South America	2.31	2.2	0.08	-
Estonia	Europe	1.07	5.6	0.81	-
Ghana	Africa	1.79	3.9	0.75	0.82
Guatemala	Central America	2.55	2.5	0.21	-
Honduras	North America	2.45	2.7	0.90	-
Hungary	Europe	1.16	4.9	0.51	0.41
India	Asia	2.03	2.7	0.65	0.65
Kenya	Africa	1.79	1.9	0.73	0.75
Malawi	Africa	1.93	2.9	0.59	0.77
Malaysia	Asia	2.25	4.9	0.50	-
Mexico	North America	2.75	3.6	0.51	0.69
Moldova	Europe	1.41	2.1	0.44	0.75
Namibia	Africa	1.03	5.7	0.40	0.62
Pakistan	Asia	2.33	2.6	0.57	0.79
Poland	Europe	1.28	4.0	0.42	-
Romania	Europe	1.64	2.6	0.42	-
Slovak Republic	Europe	1.25	3.7	0.73	0.63
South Africa	Africa	1.40	4.8	0.60	0.53
Tanzania	Africa	1.68	2.7	0.74	0.84
Turkey	Europe	1.37	3.2	0.20	0.91
Uganda	Africa	1.88	2.1	0.25	-

Notes: This table presents the list of countries studied in the paper. The WBES corruption index represents the average of firm's frequencies of bribery by each country calculated from the answers to the WBES survey question "Do firms like yours typically need to make extra, unofficial payments to service providers to get connected to telephone?" with 1= Never, 2=Seldom, Sometimes, Frequently, or Mostly, and 3=Always. The Transparency International index is directly derived from the Transparency International Global Corruption Perception Index (CPI) of in year 2002. The definition and calculation of Regulatory Governance and Regulatory Substance indexes can be found in Appendix Table 1.

Figure 1. Relationship between Frequencies of Corruption and Transparency International Global Corruption Perception Index

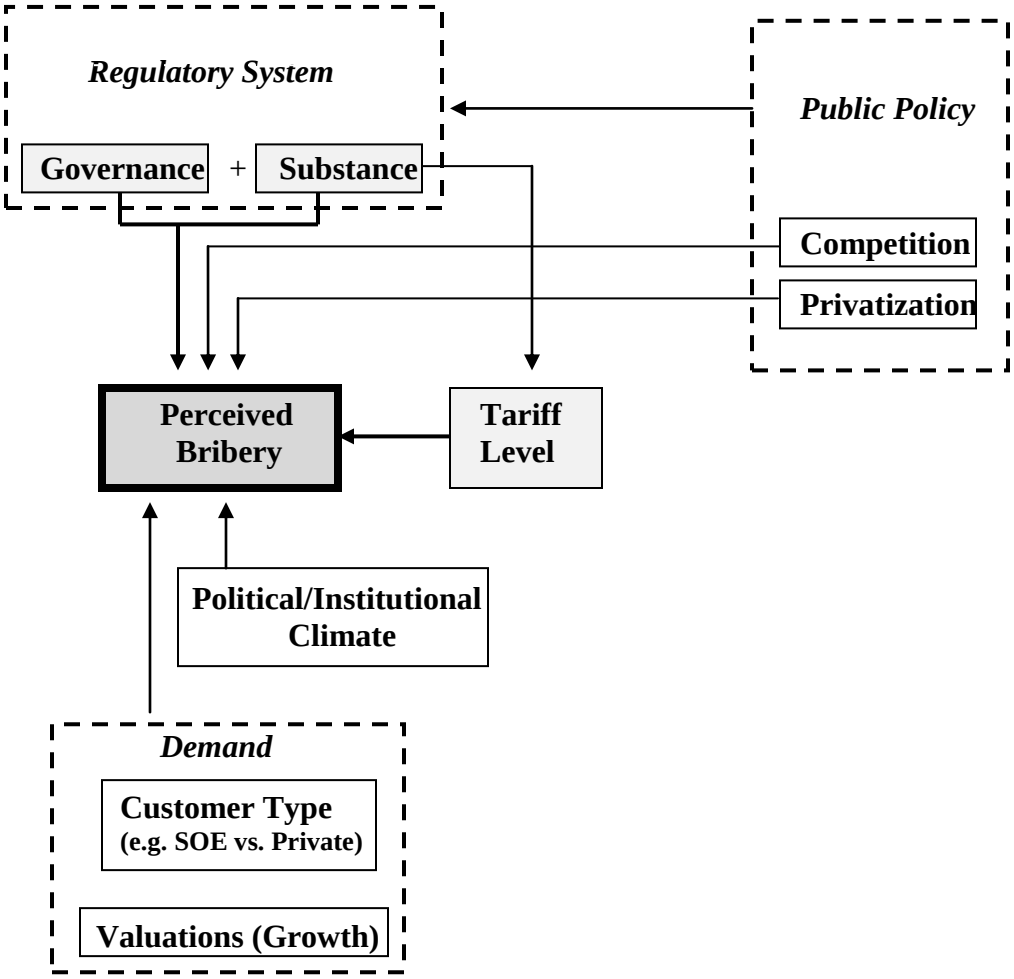


Note: WBES Frequencies of Corruption is coded between 1 and 3, with 1= Never, 2=Seldom, Sometimes, Frequently, or Mostly, 3=Always, based on answers to the question "Do firms like yours typically need to make extra, unofficial payments to service providers to get connected to telephone?" The Transparency International Global Corruption Perception Index ranges between 1 and 6, with higher value indicating less corruption. The negative correlation between WBES Frequencies of Corruption and Transparency International indicates the consistency of measurement for country corruption.

2.2. Explanatory Variables

The main explanatory variables are measures of (1) regulation systems, including regulatory governance and regulatory substance; (2) whether the operators are state-owned, partially state-owned, or fully privatized; (3) level of competition in local telephone service, and (4) the tariff level (including the installation fee and subscription fee). Appendix Table 1 provides detailed definitions for all the variables used throughout the paper. Figure 2 below illustrates the theoretical links among the factors that could affect perceived bribery. The expected signs for these factors are discussed later. First, we specify how to construct variables for these factors.

Figure 2. Factors Affecting Perceived Bribery



2.2.1. Regulatory substance

Drawing upon Levy and Spiller's (1994, 1996) and Brown et al.'s (2006) work, we employ the "World Bank Telecommunications Regulation Survey" by Wallsten et al. (2004) to construct four general indicators of regulatory substance: *Tariff Setting, Quality of Service Standards, Accountants Ratio,* and *Periodic Review*. In general, an effective regulator must have the power to set tariffs, define quality of service standards, have effective accounting systems, and conduct periodic reviews of her decisions.

The tariff setting process is important to protect infrastructure customers and gain the confidence of investors. The regulator should have the power to establish a reasonable tariff level for telecommunications services and have the capacity to monitor operator compliance. Regulation of tariffs constrains the abuse of monopoly power by the service providers and reduces their power to require side payments. We use whether the prices are regulated as a proxy for the power of the regulator on tariff setting.[15]

It is also important for regulators to set a minimum service standard that the utility providers are expected to meet (Brown et al. 2006). If the regulator can determine detailed standards for the regulated companies, make both consumers and investors aware of the nature of the service, and if the prices are set at reasonable levels, service providers will be less able to exercise discretion towards their customers, and bribes should be less frequent. Therefore, as a proxy for quality of service standard we use information on whether key performance data (i.e., call completion rates by operator, faults and faults repair, and geographical coverage rates) are collected.[16]

Audits can provide valuable information to regulators. However, developing countries often lack reliable accounting and auditing systems (Laffont, 2005). This is often due to a limited number of accounting employees; therefore, to create a measure of a regulatory agency's accounting resources, we scaled the number of accountants employed by the regulator by the annual revenues of the country's telecommunications industry (in U.S. dollars). To avoid a downwards bias of this ratio for countries with large telecommunications sectors, a value of "1" is given for the country with the maximum of this ratio, which is in Honduras (0.0869). For the other countries, the above calculated

[15] In unreported model specifications, we also added a variable for the tariff setting method. A more specific tariff setting method added to the indicator complicates the model; furthermore, the variable does not show a significant effect in the model and does not change the results.

[16] We acknowledge that the available data are imperfect measurements for determining whether a national regulator sets detailed service standards, but due to data limitations, those are the best proxies available. In developing countries, data collection has not been conducted in a systematic way. Therefore, the presence of such indicators serves as a good indicator for whether there is standardized required service performance in those countries, which is unlikely if the regulator does not bother (or is unable) to collect performance data.

ratio is divided by 0.0869. This yields a proxy variable corresponding to the *Accountants Ratio*.

Periodic regulatory review is a necessary procedure if the agency is to evaluate previous decisions and incorporate performance indicators into rate reviews. Performing such routine regulatory functions reduces regulatory discretion and puts a spotlight on managerial behavior. It can also reduce undue discrimination toward consumers and limit abusive business practices (including bribery requests). We use the answer to the question "whether there is a set period of time between regulatory reviews" as a measurement for *Periodic Review*.

Table 2. Correlation Matrix for Elements of Regulatory Substance and Regulatory Governance Indexes

	Independence	Clarity of Roles	Accountability	Transparency & Participation	Accountants Ratio	Tariff Setting	Quality of Service Standards
Clarity of Roles	0.4840*						
Accountability	0.4481*	0.0837*					
Transparency & Participation	-0.6104*	-0.1753*	-0.5364*				
Accountants Ratio	-0.2880*	0.1187*	-0.2495*	0.2068*			
Tariff Setting	-0.4396*	-0.3220*	-0.1342*	0.3809*	0.4702*		
Quality of Service Standards	-0.3460*	0.0755*	-0.0494*	0.1116*	0.4683*	0.5860*	
Periodic Review	-0.5208*	-0.3917*	-0.4599*	0.3413*	0.4525*	0.5716*	0.1496*

Note: * represents significance at 5% level

The correlation matrices for elements of this index are presented in Table 2. As the regulatory indicators are usually highly correlated, including them all together in the regression would introduce severe multicollinearity. To avoid this, we calculate an aggregate measure of regulatory substance by taking the average of these four

indicators.[17] This aggregate regulatory substance variable ranges between 0.0100 and 0.9000 in the sample, with a mean of 0.4952 and a standard deviation of 0.2175. Higher values mean tighter regulatory substance policy. The summary statistics for regulatory substance and other key variables are presented in Table 3. The country-level relationship between the regulatory substance index and the bribe frequencies is plotted in Figure 3. The pattern clearly shows that frequencies of bribes are lower in countries with stricter regulatory substance. We discuss the empirical analysis results in detail in section 3.

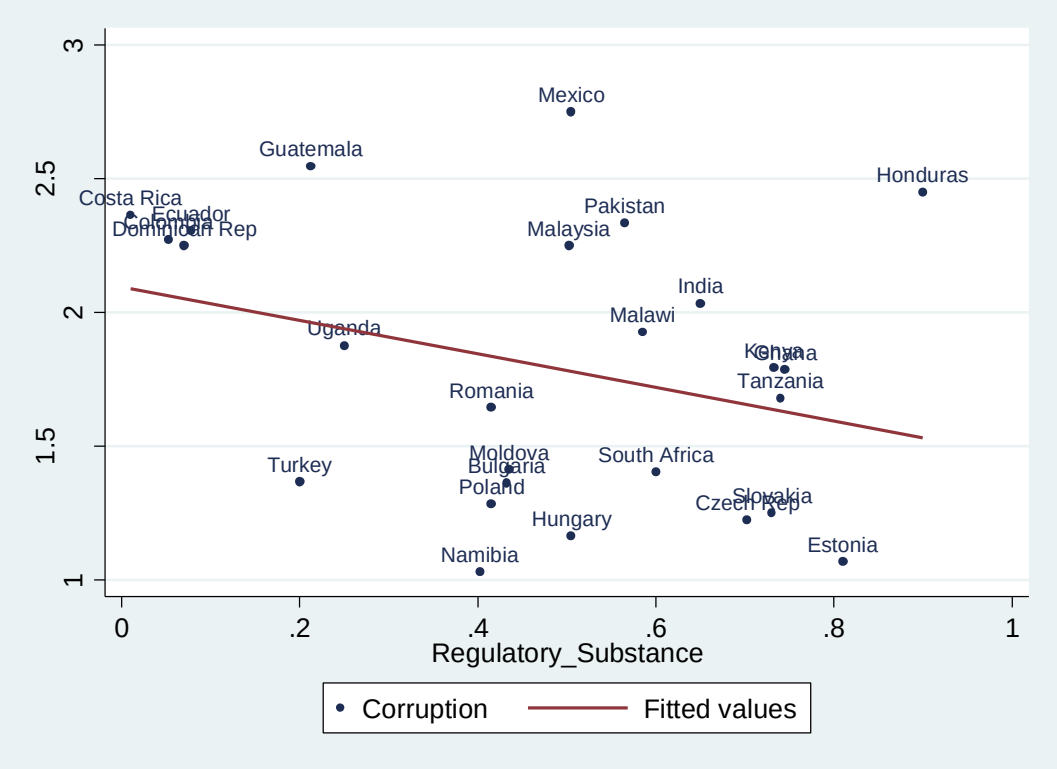
Table 3. Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
corruption	1.4304	0.5919	1	3
regulatory substance	0.4952	0.2175	0.0100	0.9000
regulatory governance	0.7492	0.1305	0.4063	0.9063
state_owned	0.0809	0.2728	0	1
partially_state_owned	0.1723	0.3777	0	1
fully privatized	0.8329	0.3100	0	1
competition (# of competitors)	1.5871	0.8572	1	51.6094
fee	0.1801	0.3458	0.0001	1.7771
smallest	0.3526	0.4778	0	1
small	0.0376	0.19.04	0	1
medium	0.0165	0.1275	0	1
large	0.0224	0.1480	0	1
largest	0.0181	0.1332	0	1
government	0.1176	0.3054	0	1
foreign	0.1070	0.2756	0	1
manufacturing	0.3629	0.4809	0	1
service	0.4481	0.4974	0	1
agriculture	0.0510	0.2200	0	1
construction	0.0944	0.2924	0	1
export	0.4134	0.4925	0	1
GDP per capita (000s of US$)	7.5314	0.9292	5.0609	8.7680
GDP growth	-2.3637	6.9923	-32.4600	11.6200
inflation	17.4894	19.0840	-0.2000	64.9000
population (in 1,000,000)	61.7000	19.1000	0.2498	1,020
urban share	56.2142	14.6669	12.1000	90.1000

Note: This table shows summary statistics for all the variables used in the main regression. Definitions for all the variables are presented in Appendix Table 1.

[17] We have also used the principal component method to construct an alternative regulatory substance index. This method does not change our main results. However, for simplicity of interpreting the regression results, we utilized the equal weighting method to construct the regulatory substance index.

Figure 3. Relationship between Frequencies of Corruption and Regulatory Substance



Note: WBES Frequencies of Corruption is coded between 1 and 3, with 1= Never, 2=Seldom, Sometimes, Frequently, or Mostly, 3=Always, based on answers to the question "Do firms like yours typically need to make extra, unofficial payments to service providers to get connected to telephone?"

2.2.2. Regulatory governance

We incorporate regulatory governance into the analysis by utilizing four elements: *Independence of the Regulator*, *Clarity of Responsibility*, *Accountability*, and *Transparency and Participation*. According to Stern (1994), Stern and Holder (1999) and Gutièrrez (2003), telecommunications regulation is far more credible in countries where regulatory governance is characterized by these four elements.

We follow the above literature to construct each regulatory governance variable by applying the same weight to each survey question.[18] After constructing four indicators to measure regulatory governance, we also define an overall index for regulatory governance by taking the average of the four individual indicators. Again, as some of the

[18] Weighting the questions differently using the principal component method does not change the regression results significantly.

regulatory governance indicators are highly correlated, to avoid multicollinearity problems, we use the overall index in the regression. The regulatory governance index ranges between 0.4063 and 0.9063 with a mean of 0.7492 and a standard deviation of 0.1305. As with the regulatory substance index, higher values of the regulatory governance index mean more comprehensive regulatory governance policy.

Compared with the regulatory substance index, the regulatory governance index is higher by about 20 percentage points on average. The difference in absolute value is largely caused by the small average value for the A*ccountants Ratio*. To make the marginal effects comparable, section 3 will compare marginal effects based on a one standard deviation change rather than the marginal effects based on actual level changes.

2.3. Tariff Level, State Ownership and Competition

Several other country-level variables are also included. First, we include a *Fee* variable as a control variable to measure tariff level, which is calculated by the sum of the monthly subscription fee and installation fee scaled by the monthly GDP per capita.[19] The range of the *Fee* variable in our sample is quite large, from 0.0001 to 1.7771. Tariffs are a critical element of telecommunications service providers; they provide price signals to consumers, determine access to service, affect the financial sustainability of firms, and reflect the extent to which competitive pressures or regulatory requirements limit above-normal profits. However, the price of services is difficult to evaluate in the context of corruption. We expect that tariff level is positively associated with frequencies of bribery for the following reasons: First, the high tariff level could be due to high service costs, which leads to low rents for telecommunications service providers. In this case, the service providers are more likely to seek extra payments to defray their high costs (or to allow installation staff to extract rents). Furthermore, if the installation fee is very high

[19] The importance of the installation is emphasized here, since the up-front fee could be introduced as an annualized value. The results are unaffected if we replace the *Fee* variable with either the monthly subscription fee or the installation fee in the regressions.

but the service quality is poor, the combination might cause users to make extra payments to the telecom provider to repair their telephone systems: users have already paid installation fees, and the incremental bribery payments are low relative to incremental benefits. Second, it is also possible that the high price of telecom service is associated with high rents to the service provider. By 2004 (when the survey was taken) telephone service was still limited in many developing countries, due to technological limitations (line-line rather than mobile phones) or affordability issues. In those areas, telephone service consumption is like a luxury good – enabling service providers to request side payments for trivial services, even when those services may be costless (such as connecting multiple phones on one line).

We also include telecoms' ownership and competition in our analysis since, as Gasmi and Recuero Virto (2010) note, infrastructure reform policies often involve the bundling of complementary initiatives. The variable *Competition* is measured by the logarithm of the number of operators within a country in 2001. The number of operators ranges from 1 to 5 in our sample. The variable for telecoms' ownership is measured with three dummy variables: state-owned, partially state-owned, or fully privatized. The empirical studies on the effects of privatization on corruption yield mixed results. Vagliasindi (2011) finds that state-owned utilities' susceptibility varies widely - under certain conditions, state-owned utilities could have low-levels of corruption. Martimont and Straub (2009) find that in Latin America, privatization seemed to foster greater corruption, which (they argued) could explain the lack of popularity of infrastructure reforms in the region. In contrast, Clarke and Xu's (2004) find that the presence of privatization and competition reduces corruption. Despite of the widespread privatization of public utilities, in some developing countries, telecoms are still state-owned or involve partial government ownership. Using a broader database (and different indicators of corruption), the current study provides another cross-country test of the impact of telecoms' ownership on corruption.

2.4. Other Firm-specific Characteristics and Country-level Control Variables

Firm-specific control variables, which are derived from the WBES/EECAS survey questions, include firm ownership, firm size, sector, etc. We expect a firm's ownership to affect utility bribe payments, though there are some counteracting forces: private firms tend to have less political influence than government-owned firms, so they might be less able to resist bribe demands (Clarke and Xu, 2004); on the other hand, small business firms are likely to suffer from cash flow problems, which reduce their ability to pay bribes (Clarke and Xu, 2004); firms from different sectors have different valuations of (and demands for) telecom service and thus may exhibit different frequencies of paying bribery, holding everything else constant. We also include *export* as a dummy variable: this takes on the value of one if the firm exports, and zero otherwise. An export-oriented firm will place a particularly high value on telecommunications services.

In addition, we control for many country-specific attributes, including the *logarithm of GDP per capita, the logarithm of population, GDP growth, inflation* level, and *Urban Share* (Urban population as a percentage of total population) as they may reflect the potential gain to business customers from having a working phone system. Willingness to pay for service translates into a willingness to pay bribes.

3. Estimation

3.1 Baseline Regression

Due to the discrete nature of the dependent variable, we mainly use an ordered probit model in our regression analysis. We also compute heteroskedastic robust standard errors clustered at the country level to allow the errors to be correlated within countries. We first report results for regressions that include regulatory substance index (columns 1-2 of Table 4-A) and regulatory governance index (column 3 of Table 4-A), respectively. We then include both of the indexes together (column 4 of Table 4-A). Finally, we aggregate these into one regulation index, constructed by taking the average of the

regulatory governance and substance index. For all these regressions, we control for firm size and industry dummy variables.

Table 4-A. Ordered Probit Regression: Determinants of Corporate Corruption

	(1)	(2)	(3)	(4)	(5)
regulatory substance	-1.2995***	-1.8496***		-2.8162**	
	(0.3532)	(0.5041)		(1.3607)	
regulatory governance			-2.0875***	-1.9690***	
			(0.5366)	(0.4550)	
regulation					-4.4227***
					(0.9860)
fee	0.5293***	0.2244	0.2590***	0.6082***	0.5336***
	(0.0791)	(0.1420)	(0.0990)	(0.2193)	(0.1303)
competition	-0.2219	-0.6548***	-0.7971***	-1.4128***	-1.3006***
	(0.1551)	(0.2443)	(0.1182)	(0.3733)	(0.2280)
state_owned	0.7770***	0.4582***	0.8025***	0.8421***	0.8561***
	(0.1560)	(0.1574)	(0.2187)	(0.2099)	(0.2174)
partially_state_owned	0.4799**	0.5460**	-0.1381	0.1340	0.0548
	(0.1896)	(0.2218)	(0.1633)	(0.2162)	(0.1285)
government	-0.8895***	-0.9047***	-0.8361***	-0.8288***	-0.8303***
	(0.1096)	(0.1113)	(0.1250)	(0.1227)	(0.1234)
foreign	-0.2067**	-0.2054**	-0.1042	-0.0760	-0.0822
	(0.0969)	(0.1016)	(0.1113)	(0.1127)	(0.1118)
export	-0.1111*	-0.0976	-0.0753	-0.0581	-0.0631
	(0.0619)	(0.0617)	(0.0681)	(0.0706)	(0.0689)
GDP per capita		-0.3005**	-0.6498***	-0.2887	-0.3899***
		(0.1172)	(0.0984)	(0.1766)	(0.0641)
GDP growth		0.0008	0.0237***	0.0337***	0.0323***
		(0.0107)	(0.0050)	(0.0082)	(0.0068)
inflation		0.0012	0.0172***	0.0126***	0.0146***
		(0.0048)	(0.0043)	(0.0044)	(0.0046)
population		0.2163**	0.4154***	0.5732***	0.5423***
		(0.1098)	(0.0732)	(0.1216)	(0.0866)
urban share		-0.0052	0.0212***	-0.0106	-0.0023
		(0.0091)	(0.0075)	(0.0138)	(0.0043)
Industry Dummies	Yes	Yes	Yes	Yes	Yes
Firm Size Dummies	Yes	Yes	Yes	Yes	Yes
N	3731	3731	2786	2786	2786
pseudo R-sq	0.1160	0.1476	0.1376	0.1396	0.1395

Note: The regressions are run based on ordered probit model, which is based on standard maximum likelihood estimation. The dependent variable "Corruption" is based on answers to the question - Do firms like yours typically need to make extra, unofficial payments to service providers to get connected to telephone? (1 = never, 2 = seldom, sometimes, frequently, mostly and 3 = always). Regressions include six dummies for firm size based upon employment and five dummies based upon sector of operations - manufacturing; agriculture, construction, service, and other. All the other variables are defined in Appendix Table 1. Standard errors are in parentheses. Standard errors are Huber-White standard errors allowing firms' error terms within country to be correlated for regressions. i.e., clustered errors at the country level. * significant at 10% level; ** significant at 5% level; *** significant at 1% level.

In order to demonstrate the magnitude of the effectiveness of regulatory policies on corruption control, we further compute the marginal effects of regulation on the probabilities that firms choose each of the three corruption levels (from "never" to "always"). For this, we use the coefficient estimates from the model that includes both regulation indexes, i.e. regression (4) in Table 4-A.

Table 4-B presents the marginal effects for an "average" enterprise. As we noted earlier, to make the marginal effects comparable, we compare marginal effects based on a one standard deviation change rather than the marginal effects based on actual level changes. We also report impacts if the variable changes from the minimum value to the maximum value. As can be seen, the magnitudes of the economic impacts are quite large. For instance, the estimated results suggest that a one standard deviation increase in the regulatory substance index would lead to a 17.54 percentage point decrease in the probability that a firm reports that it needs to pay the additional unofficial payments with frequencies ranges between never and always. If the regulatory substance index increases from the minimum to maximum in the sample, the probability that a firm reports such payment decreases by 43.74 percentage points. The effects are substantial, since about 33% of the firms in the sample report that they need to pay side payments in the middle range of frequencies (between never and always), while about 60% of the firms say they do not need to bribe the telecom service providers.

Similarly, the estimates imply that a one standard deviation increase in the regulatory governance index value would lead to an 8.51 percentage point decrease in the probability that a firm reports it needs to pay the additional unofficial payments from seldom to mostly. If the regulatory governance index increases from the minimum to maximum in the sample, the probability that a firm reports such payment decreases by 29.95 percentage points.

Table 4-B. Marginal Effects on Bribery for an "Average" Enterprise

		Seldom ~ Mostly	Always
regulatory substance	one standard dev. increase	-0.1754**	-0.0272**
	change from min to max	-0.4374**	-0.0971**
regulatory governance	one standard dev. increase	-0.0851***	-0.0126***
	change from min to max	-0.2995***	-0.0746***
fee	one standard dev. increase	0.0632***	0.0093***
	change from min to max	0.2634***	0.0990***
state_owned	change from 0 to 1	0.2398***	0.0861***
partially_state_owned	change from 0 to 1	0.0443	0.0070
competition	one standard dev. increase	-0.1941***	-0.0305***
	change from min to max	-0.5102***	-0.0701***
government	one standard dev. increase	-0.0878***	-0.0130***
	change from min to max	-0.2439***	-0.0230***
foreign	one standard dev. increase	-0.0070	-0.0010
	change from min to max	-0.0250	-0.0035
export	change from 0 to 1	-0.0192	-0.0028
GDP per capita	one standard dev. increase	-0.0903	-0.0134
	change from min to max	-0.3248	-0.0765
GDP growth	one standard dev. increase	0.0756***	0.0112***
	change from min to max	0.4090***	0.0543***
inflation	one standard dev. increase	0.0821***	0.0122***
	change from min to max	0.2468***	0.0575***
population	one standard dev. increase	0.2676***	0.0448***
	change from min to max	0.3330***	0.5935***
urban share	one standard dev. increase	-0.0525	-0.0077
	change from min to max	-0.2024	-0.0394

Note: This table shows marginal effects on bribery for an "average" enterprise with explanatory variable one standard deviation increase or change from min to max. The regression is run based on ordered probit model as of regression (4) of Table 5-A. All the variables are defined in Appendix Table 1. * significant at 10% level; ** significant at 5% level; *** significant at 1% level.

The results show that overall, regulatory substance has a strong effect in controlling for corruption: an impact often ignored in earlier research.[20] It is not intuitively obvious why regulation has a greater impact on corruption control when bribery happens in the middle range of frequencies rather than *always*. One reason could be that the benefits for those firms that need to pay side payments are marginal. If the regulatory intervention is effective in controlling bribery, top executives of firms supplying telecommunications services will be more likely to develop mitigation programs that reduce extortion and bribes: the risk of penalties from bribery might outweigh the benefits service providers

[20] We think to draw a conclusion of the magnitude of the effects for regulatory governance and substance on corruption control needs to be cautious, but our empirical results clearly show that at least regulatory substance is an important factor to deter corporate corruption which is often ignore in the past empirical analysis.

can obtain.[21] If these benefits accrue to installers or other labors, then higher level managers might be engaging in more active prevention programs in those situations—having an impact on the margin.

Tables 4-A and 4-B also present other important findings. First, the regression results often predict reduced bribery in the presence of privatization and competition. This is consistent with Clarke and Xu's (2004) findings. Second, the tariff level (*Fee*) enters positive and is statistically significant in all regressions. This result supports our previous conjecture that high tariff levels tend to be associated with more bribery. Third, the firm and country control variables yield some interesting results, too. In all specifications, government-owned firms purchasing telecommunications services are less likely to pay bribes than their privately owned counterparts. Other things equal, government-owned firms are more likely to say that they *never* need to do so. This finding suggests that in developing countries, private firms are much more vulnerable to unofficial payment requests than government-owned firms. It seems that state-owned customers have "protection" stemming from their connections to powerful ministries. This result also suggests that justice is not practiced in an even-handed fashion in developing and transitional economies. In addition, the coefficients on the *GDP growth* are positive and statistically significant in most of the models for the frequencies of bribery, suggesting that firms in countries with higher GDP growth report more exposure to bribery, due to the fact that telecom service in those countries may be more valuable than in other countries.

In summary, the preliminary results indicate that a regulatory environment featuring strong regulatory governance and substance reduces corporate corruption in the telecom sector. The effect of regulation on corruption control is not only statistically

[21] One might ask, "Who benefits from a bribe?" The answer is both parties—otherwise the transaction would not occur. Of course, the customer would be even better off if there were no bribe. Furthermore, the legitimacy of the governance system is increased when bribery is infrequent.

significant, but also economically relevant; furthermore, the econometric model fits the data well. In terms of the fit, the Pseudo R^2 stays over 10%, which is high for these types of cross-firm empirical studies (Beck et al., 2006).

Tables 4-A and 4-B present the main regression results. Although we use non-linear model here, a linear model yields similar quantitative results. Appendix Table 2 replicates the regression in Table 4-A using the ordinary least square (OLS) model.

3.2. Different Categorizations for Corruption

To reduce the possibility that idiosyncratic firm responses will bias our results since the answers across each category are unbalanced (Beck, Demirgüç-Kunt and Levine, 2006), we use the dummy variable to represent corruption ("0" if "never" is being answered on perceived corruption and "1" if otherwise) and probit model to repeat the entire analysis. The probit regression results are presented in Table 5 (column 1-2).[22] We also present our results for using six categories of corruption and ordered probit model in column 3-4 of Table 5. For all these regressions, we control for firm size and industry dummies. The impacts of regulatory substance and regulatory governance remain negative and statistically significant after we use different categorizations for corruption, suggesting that our main results are robust to different categorizations of bribe frequencies.

[22] To further alleviate this concern, we use probit models to repeat all the ordered probit analysis in the paper, we do not find any inconsistent results. Following Beck, Demirgüç-Kunt and Levine (2006), we also omitted each country one-at-a-time and we do not find that firm responses from a single country drive the results. These results are not reported due to space limitations; they are available from the authors upon request.

Table 5. Determinants of Corporate Corruption: Different Categorizations

	(1)	(2)	(3)	(4)
Categories	Two	Two	Six	Six
Model	Probit	Probit	Ordered Probit	Ordered Probit
regulatory substance	-1.7404**		-3.7793***	
	(0.8831)		(1.2930)	
regulatory governance	-1.8261***		-1.6683***	
	(0.4438)		(0.4288)	
regulation		-3.6114***		-4.5753***
		(0.7878)		(0.9339)
fee	0.5517***	0.5602***	0.7983***	0.6124***
	(0.1088)	(0.1592)	(0.2137)	(0.1149)
competition	-1.1956***	-1.2084***	-1.5785***	-1.3020***
	(0.2184)	(0.1738)	(0.3593)	(0.2226)
state_owned	0.7015**	0.7009**	0.8064***	0.8412***
	(0.2787)	(0.2750)	(0.2130)	(0.2240)
partially_state_owned	0.0232	0.0312	0.1569	-0.0412
	(0.1991)	(0.1241)	(0.2118)	(0.1282)
government	-0.7988***	-0.7987***	-0.7950***	-0.7989***
	(0.1262)	(0.1256)	(0.1344)	(0.1359)
foreign	-0.1128	-0.1123	-0.0702	-0.0867
	(0.0754)	(0.0747)	(0.1113)	(0.1106)
export	-0.0579	-0.0575	-0.0623	-0.0751
	(0.0517)	(0.0546)	(0.0642)	(0.0623)
GDP per capita	-0.3836***	-0.3732***	-0.1265	-0.3781***
	(0.1107)	(0.0636)	(0.1649)	(0.0612)
GDP growth	0.0335***	0.0336***	0.0361***	0.0325***
	(0.0078)	(0.0082)	(0.0079)	(0.0063)
inflation	0.0146***	0.0144***	0.0069	0.0119**
	(0.0050)	(0.0054)	(0.0043)	(0.0047)
population	0.5371***	0.5408***	0.6200***	0.5443***
	(0.1109)	(0.0700)	(0.1148)	(0.0846)
urban share	-0.0061	-0.0069**	-0.0235*	-0.0030
	(0.0118)	(0.0035)	(0.0129)	(0.0040)
Industry Dummies	Yes	Yes	Yes	Yes
Firm Size Dummies	Yes	Yes	Yes	Yes
N	2786	2786	2786	2786
pseudo R-sq	0.1558	0.1558	0.1084	0.1078

Note: Regression (1)-(2) are run based on probit model, with dependent variable equals to zero if the answer is "never" to the question - Do firms like yours typically need to make extra, unofficial payments to service providers to get connected to telephone?, and one if otherwise. Regressions (3)-(4) are run based on ordered probit model, which is based on standard maximum likelihood estimation. The dependent variable "Corruption" is based on answers to the above question with 1 = never, 2 = seldom, 3 = sometimes, 4 = frequently, 5 = mostly and 6 = always. All regressions include six dummies for firm size based upon employment and five dummies based upon sector of operations - manufacturing; agriculture, construction, service, and other. All the other variables are defined in Appendix Table 1. Standard errors are Huber-White standard errors allowing firms' error terms within country to be correlated for regressions. i.e., clustered errors at the country level. * significant at 10% level; ** significant at 5% level; *** significant at 1% level.

3.3. Controlling for Other Macro Country-Level Variables

A large body of research has examined the effects of country-level variables on corruption. Even though most of these variables are not expected to affect corporate corruption in the utility sector, they may affect overall country level corruption, which could indirectly affect the utility corruption (Clarke and Xu, 2004). To the extent that some of the unobservable elements can be correlated with country-level variables, excluding them could cause omitted variable bias. To check this, we utilize data from the Worldwide Governance Indicators (WGI) project related to political rights and democracy; in addition, we also added government spending and the ratio of fuel, ore and metal exports to GDP, respectively, to the base regression, i.e., regression (4) of Table 4-A (Appendix Table 1 contains detailed definitions). The results for coefficient estimation are presented in Table 6. The coefficients on these control variables are all statistically significant. The main results for regulatory substance and regulatory governance remain negative and statistically significant even after the inclusion of these variables. Overall, firms have less frequency to pay bribes in countries with better political rights, more natural resource exports, a higher democracy level, and greater government expenditures.

3.4. Controlling for Institutional Environment

Another source of omitted variable bias might come from characteristics of the institutional environment. As pointed out by Beck et al. (2006), countries with different general institutional environment may choose different regulatory practices. At the same time, these different institutional traits may affect the integrity of regulation in the telecommunications industry. Following Beck et al. (2006), we examine whether omitting institutional environment variables can cause a serious bias in our estimates.

Table 6. Ordered Probit Regression with More Macro Country-Level Variables

	(1)	(2)	(3)	(4)
regulatory substance	-3.3226**	-2.4971***	-3.8700***	-2.4917**
	(1.5227)	(0.9328)	(0.9864)	(1.1766)
regulatory governance	-6.1278**	-3.5069***	-2.9975***	-1.0599**
	(2.4337)	(0.5802)	(0.5504)	(0.5266)
political right	-0.6944**			
	(0.3270)			
fuel_ore_metal		-0.0821**		
		(0.0377)		
democracy			-0.8789***	
			(0.1940)	
government expenditure				-1.9740***
				(0.5816)
fee	0.4872**	0.8130***	0.0322	-0.0149
	(0.2442)	(0.0633)	(0.1558)	(0.1685)
competition	-2.2875***	-1.6071***	-2.1111***	-2.0307***
	(0.5457)	(0.2540)	(0.3439)	(0.4534)
State-owned	-1.3870	0.6263***	-0.7144**	0.3335
	(0.9724)	(0.2266)	(0.3430)	(0.2140)
Partially state-owned	0.0849	-0.2416	0.8404***	0.4947*
	(0.2757)	(0.1572)	(0.2710)	(0.2622)
government	-0.8229***	-0.7926***	-0.7776***	-0.8243***
	(0.1239)	(0.1383)	(0.1349)	(0.1231)
foreign	-0.0637	-0.0492	-0.0370	-0.0462
	(0.1112)	(0.0691)	(0.1064)	(0.1112)
export	-0.0448	-0.0442	-0.0469	-0.0363
	(0.0710)	(0.0553)	(0.0637)	(0.0708)
GDP per capita	-0.6360*	-0.4860***	-0.0956	-0.1330
	(0.3700)	(0.1731)	(0.1302)	(0.1842)
GDP growth	0.0187*	0.0342***	-0.0009	0.0131*
	(0.0101)	(0.0043)	(0.0077)	(0.0071)
inflation	0.0030	0.0069**	-0.0052	0.0127***
	(0.0068)	(0.0030)	(0.0049)	(0.0043)
population	0.9687***	0.5669***	0.9855***	0.4561***
	(0.2610)	(0.0822)	(0.1458)	(0.1046)
urban share	0.0200	0.0125	-0.0215**	-0.0255*
	(0.0308)	(0.0141)	(0.0101)	(0.0154)
Industry Dummies	Yes	Yes	Yes	Yes
Firm Size Dummies	Yes	Yes	Yes	Yes
N	2786	2786	2786	2786
pseudo R-sq	0.1449	0.1103	0.1156	0.1457

Note: The regressions are run with ordered probit, which is based on standard maximum likelihood estimation. The dependent variable "Corruption" is based on answers to the question - Do firms like yours typically need to make extra, unofficial payments to service providers to get connected to telephone? (1 = never, 2 = seldom, sometimes, frequently, mostly and 3 = always). Regressions include six dummies for firm size based upon employment and five dummies based upon sector of operations - manufacturing; agriculture, construction, service, and other. All the other variables are defined in Appendix Table 1. Standard errors are Huber-White standard errors allowing firms' error terms within country to be correlated for regressions. i.e., clustered errors at the country level. * significant at 10% level; ** significant at 5% level; *** significant at 1% level.

To control for the country's institutional environment, we further include a series of political and institutional quality indices – the World Governance Indices (WGI). The WGI (Kaufmann et al., 2006) are constructed with six indicators, based on 276 individual variables from 31 sources, produced by 25 different organizations. In particular, these indicators measure six different dimensions of governance: (1) *Voice and Accountability*, which measures public participation and media freedom; (2) *Political Stability and Absence of Violence*, which measures legal protection; (3) *Government Effectiveness*, which measures bureaucratic quality; (4) *Regulatory Quality*, which measures policy implementation ability; (5) *Rule of Law*, which measures law enforcement and legal system efficiency; and (6) *Control of Corruption*, which measures the extent to which public power can resist corruption.[23] The results for coefficient estimation are presented in Table 7. Again, the coefficients are consistent with our previous results: both regulatory governance and regulator substance have negative signs in all regressions, and almost all of them are statistically significant at the 1% level. Moreover, all the estimated coefficients of WGI variables are negative and statistically significant, suggesting that a better general institutional environment lowers the degree to which firms have to bribe the telecom sector to obtain service.

3.5. Endogeneity and Instrumental Variable (IV) Estimation

Although our results so far have just shown a correlation between corruption and regulation, the causal effect is more likely to run from better regulation to less corruption since it is hard to argue that an individual firm's views about corruption will influence a country's telecom regulatory policies. Nonetheless, there may still be a feedback effect running from the private sector to the regulatory authorities: a high level of corporate corruption may lead to pressure for more effective regulation (Beck et al. 2006). We use instrumental variable estimation to address this endogeneity concern.

[23] Appendix Table 1 defines these variables in detail.

Table 7. Ordered Probit Regression with Institutional Control Variables

	(1)	(2)	(3)	(4)	(5)	(6)
regulatory substance	-4.8071***	-4.1773***	-1.0795**	-2.2333**	-1.6755**	-1.9012**
	(0.9639)	(1.0401)	(0.5010)	(0.9752)	(0.8217)	(0.8963)
regulatory governance	-6.7496***	-2.0931***	-1.7040***	-1.4625***	-1.2085**	-3.1371***
	(0.9105)	(0.5782)	(0.4928)	(0.5480)	(0.5670)	(0.6618)
fee	0.7660***	1.0070***	0.3667***	0.8256***	0.4768***	0.4982***
	(0.1560)	(0.1869)	(0.0641)	(0.1691)	(0.1443)	(0.1493)
competition	-2.8178***	-1.9947***	-0.6913***	-1.0862***	-1.0110***	-1.1698***
	(0.3264)	(0.2893)	(0.1092)	(0.2788)	(0.2246)	(0.2267)
state_owned	-0.3166	0.5785***	0.3009***	1.0321***	0.0773	0.5133***
	(0.2380)	(0.1887)	(0.0885)	(0.1902)	(0.2344)	(0.1849)
partially_state_owned	0.9778***	0.2416	0.4086***	0.4231**	0.6169***	0.4574**
	(0.2195)	(0.1760)	(0.1345)	(0.1930)	(0.2013)	(0.2107)
government	-0.8232***	-0.8113***	-0.8404***	-0.8221***	-0.8414***	-0.8454***
	(0.0958)	(0.0952)	(0.0954)	(0.0947)	(0.0958)	(0.0957)
foreign	-0.1101	-0.0754	-0.2777***	-0.0684	-0.1241	-0.0999
	(0.0922)	(0.0932)	(0.0250)	(0.0937)	(0.0928)	(0.0931)
export	-0.0814	-0.0716	-0.0224	-0.0634	-0.0766	-0.0552
	(0.0548)	(0.0547)	(0.0211)	(0.0546)	(0.0545)	(0.0546)
GDP per capita	-0.1523	0.0355	-0.0529	-0.0699	-0.0140	-0.3365**
	(0.1512)	(0.1795)	(0.0515)	(0.1527)	(0.1544)	(0.1486)
GDP growth	0.0450***	0.0526***	0.0224***	0.0559***	0.0308***	0.0333***
	(0.0076)	(0.0086)	(0.0038)	(0.0117)	(0.0071)	(0.0072)
inflation	0.0115**	0.0089	0.0090***	0.0226***	0.0119**	0.0181***
	(0.0052)	(0.0054)	(0.0031)	(0.0069)	(0.0048)	(0.0054)
population	0.8850***	0.6917***	0.1677***	0.3886***	0.5107***	0.3955***
	(0.0928)	(0.0894)	(0.0620)	(0.1162)	(0.0770)	(0.0860)
urban share	-0.0180	-0.0311**	-0.0013	0.0008	-0.0143	0.0040
	(0.0119)	(0.0137)	(0.0071)	(0.0124)	(0.0105)	(0.0120)
voice and accountability	-1.8915***					
	(0.2762)					
political stability and absence of violence		-0.6038***				
		(0.1389)				
government effectiveness			-0.6131**			
			(0.2906)			
regulatory quality				-1.0032***		
				(0.3874)		
rule of law					-1.1228***	
					(0.2548)	
control of corruption						-0.8403***
						(0.2662)
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Firm Size Dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	2786	2786	2786	2786	2786	2786
pseudo R-sq	0.1514	0.1441	0.1409	0.1412	0.1448	0.1423

Note: The regressions are run with ordered probit, which is based on standard maximum likelihood estimation. The dependent variable "Corruption" is based on answers to the question - Do firms like yours typically need to make extra, unofficial payments to service providers to get connected to telephone? (1 = never, 2 = seldom, sometimes, frequently, mostly and 3 = always). Regressions include six dummies for firm size based upon employment and five dummies based upon sector of operations - manufacturing; agriculture, construction, service, and other. All the other variables are defined in Appendix Table 1. Standard errors are Huber-White standard errors allowing firms' error terms within country to be correlated for regressions. i.e., clustered errors at the country level. * significant at 10% level; ** significant at 5% level; *** significant at 1% level.

In particular, we use the absolute value of a country's latitude, financial depth, ideologies of voters, checks and balances in the governance, and ideological polarization as instrumental variables (IVs). We chose the absolute value of a country's latitude as our instrumental variable based on the recent research building on endowment theory, which focuses on the roles of geography, culture, and the disease environment in shaping institutional development (Easterly and Levine, 1997; Beck et al., 2003). The variable has also been used in recent corruption studies as instrumental variables of regulation and institutions (e.g. Beck et al., 2006; Houston et al., 2011). The basic idea of including the absolute value of a country's latitude as an instrumental variable is that European colonization shapes the country institutions and policy systems, and as Beck et al. (2006) have argued that European tendency to extracting natural resources generates more powerful administrative structures. Since Europeans usually do not settle in tropical climates, more temperate climates are usually associated with more European settlers and more egalitarian policies.

Based on the work by Li and Xu (2002), who study the determinants of telecommunications sector reforms, we use some of the special determinants that affect telecommunications regulation but otherwise do not affect corruption perception for non-telecommunications companies as our other instrumental variables. These include financial depth, ideologies of voters, checks and balances in the government, and ideological polarization. The variables have been shown to be important determinants of privatization and competition in the telecommunications sector. The detailed definitions are shown in Appendix Table 1. We argue that it is also reasonable to use them to instrument the regulation index because privatization, competition and regulation are inter-related policies in regulatory reforms. Based on Li and Xu's (2002) argument, the ideas for using these variables as IVs are as follows: (1) Businesses that rely heavily on the telecommunications services are the main beneficiaries of regulatory policy reforms. Among businesses, the financial service sector is one of the largest users of such services.

Therefore, countries with relatively large financial sectors are more likely to implement reforms in the telecommunications sector; (2) Ideologies of voters and politicians can help explain regulatory changes (Kalt and Zupan, 1984). In particular, parties with different ideologies may prefer divergent policies; for example, right-wing parties are more likely to make regulatory reforms (though crony capitalism can limit these reforms); and (3) Countries with more checks and balances can have some veto players who are in a position to block regulatory reforms more effectively.

Before we show our two-stage least squares (2SLS) estimation results, it is worth noting that, given the different context of our paper, the IVs we borrow may not totally eliminate the endogeneity bias here. It is plausible that some of the IVs may affect corruption directly rather than through regulation. For example, different ideological inclinations are more likely in democratic countries, and democracy is also considered as a determinant of corruption. Without good ideas of to what extent such direct correlations may contaminate the 2SLS estimates, we tend to interpret our 2SLS results as merely a sensitivity test rather than the true causal effects of regulation on corruption.

Table 8 reports results from 2SLS estimation based on specification as in regression (4) of Table 4-A. The F-statistics in the first stage indicate that the coefficients on the instruments are significantly different from zero at the 1% level. The over-identifying restrictions are not rejected at any significance level (1%, 5% or 10%) for all specifications. The R-square in the first stage estimation is above 95%, suggesting a good model of fit. After the instrumentation, the key explanatory variables – regulatory governance and substance – and other explanatory variables all remain the same signs. There are no significant changes from the 2SLS estimation, suggesting that our main analysis does not suffer from serious endogeneity bias.

Table 8. Instrumental Variable Estimation

	(1)	(2)
regulatory substance	-1.2534**	
	(0.4481)	
regulatory governance	-0.8994**	
	(0.2769)	
regulation		-1.9115**
		(0.4806)
fee	0.3004***	0.2650***
	(0.0647)	(0.0513)
competition	-0.6388***	-0.5746***
	(0.1188)	(0.0964)
state_owned	0.4112**	0.4074**
	(0.1262)	(0.1297)
partially_state_owned	0.1086	0.0787
	(0.0575)	(0.0414)
government	-0.2749***	-0.2752***
	(0.0408)	(0.0413)
foreign	-0.0414	-0.0447
	(0.0234)	(0.0274)
export	-0.0259	-0.0280
	(0.0225)	(0.0214)
GDP per capita	-0.1076	-0.1490***
	(0.0525)	(0.0176)
GDP growth	0.0177***	0.0169***
	(0.0017)	(0.0020)
inflation	0.0064**	0.0071**
	(0.0023)	(0.0016)
population	0.2375***	0.2150***
	(0.0443)	(0.0311)
urban share	-0.0067	-0.0032*
	(0.0041)	(0.0013)
Industry Dummies	Yes	Yes
Firm Size Dummies	Yes	Yes
Sargan's overidentification test (p-value)	0.1292	0.1511
1st-stage F-test (p-value)	0.0000	0.0000
1nd-stage adjusted R2	0.9854	0.9799
N	2786	2786
R-sq	0.2177	0.2164

Note: The regressions are run with instrumental variables based on standard maximum likelihood estimation. The instruments in are the absolute value of a country's latitude, financial depth, ideologies of voters, checks and balances in the governance, and ideological polarization. The dependent variable "Corruption" is based on answers to the question - Do firms like yours typically need to make extra, unofficial payments to service providers to get connected to telephone? (1 = never, 2 = seldom, sometimes, frequently, mostly and 3 = always). Regressions include six dummies for firm size based upon employment and five dummies based upon sector of operations - manufacturing; agriculture, construction, service, and other. All the other variables are defined in Appendix Table 1. * significant at 10% level; ** significant at 5% level; *** significant at 1% level.

4. Nonlinear Effects – Interaction Analysis

In Table 9, we include interaction terms to test whether the effects of regulatory substance vary by other country-level variables.[24] More specifically, in regression (1) – (6) of Table 9, we add the interaction between regulatory substance and state-owned dummy variable (column 1), interaction between regulatory substance and partially state-owned dummy variable (column 2), both regulatory substance and the state ownership interaction terms (column 3), interaction between regulatory substance and competition (column 4), interaction between regulatory substance and the tariff level (*Regulation*High Fee*)[25](column 5), and interaction between regulatory substance and government effectiveness (column 6).

We find that (1) the effects of regulatory substance on corruption are more significant in countries with state-owned or partially state-owned telecoms; (2) the effects of regulatory substance on corruption control are more pronounced within competitive telecommunications markets; (3) an extremely low price for telecom service may provide substantial financial leeway for firms to pay extra money (via bribery) even in the absence of effective regulatory substance; and (4) the country's government effectiveness serves as a substitute for regulatory substance as a deterrence to corporate corruption. These findings are important as they suggest that the government and private sector should work together to create a more efficient regulatory framework, a competitive market with reasonable prices, in order to reduce telecom sector facilitation payment issues that hinders firm operations and artificially limits growth potential.

[24] We searched the literature and to our best knowledge, the econometric estimators for calculating the marginal effects of interaction terms in the full value range of covariates have not been developed for ordered probit models. Although we use non-linear model here, a linear model would yield similar quantitative results as we show in Appendix Table 2 that the results for both models without interactions are very similar for our sample. Given the concern of interpreting the results for interaction terms in non-linear models, we confirm all our findings with OLS regressions and we find that the interaction effects using ordered probit model are consistent with those using OLS model. These results are not reported in the paper but available from the author upon request.

[25] We define *High Fee =1* if the tariff level is above the medium of the overall sample, and 0, otherwise.

Table 9. Ordered Probit Regression with Interaction Terms

	(1)	(2)	(3)	(4)	(5)	(6)
regulatory substance	-3.2964**	-1.7024**	-0.3610	-3.5498***	-3.2188**	-1.3537
	(1.5257)	(0.7664)	(0.9560)	(1.2903)	(1.2854)	(1.5358)
regulatory governance	-1.4467***	-0.1938	-0.4918	-2.6651***	-1.5036***	-9.4404***
	(0.4634)	(0.7944)	(0.8120)	(0.6068)	(0.4187)	(2.3290)
fee	0.6888**	0.3704***	0.0799	0.9992***	0.9085***	1.1076***
	(0.2685)	(0.1310)	(0.1700)	(0.2835)	(0.2270)	(0.2387)
competition	-1.4664***	-1.4679***	-1.2421***	-0.3208	-1.5023***	-1.0371***
	(0.4131)	(0.2735)	(0.2901)	(0.6126)	(0.3574)	(0.2808)
state_owned	2.5279***	0.7037***	3.6529***	0.8358***	0.7751***	0.4693**
	(0.9162)	(0.2081)	(0.8064)	(0.2028)	(0.2098)	(0.2058)
partially_state_owned	0.1623	3.8689**	4.6738***	0.2020	0.2177	1.6421***
	(0.2165)	(1.7422)	(1.7435)	(0.2316)	(0.2235)	(0.6111)
state_owned x regulatory substance	-2.5361*		-4.3702***			
	(1.4986)		(1.2934)			
partially_state_owned x		-5.9323**	-7.2146***			
regulatory subsance		(2.6008)	(2.5911)			
competition x regulatory substance				-3.1405*		
				(1.6189)		
high fee x regulatory substance					-0.3543***	
					(0.1373)	
government effectiveness						-7.4092***
						(2.2638)
government effectiveness x						5.6176***
regulatory substance						(1.7945)
government	-0.7890***	-0.8066***	-0.7989***	-0.7896***	-0.7947***	-0.7958***
	(0.1347)	(0.1367)	(0.1372)	(0.1352)	(0.1330)	(0.1366)
foreign	-0.0517	-0.0919	-0.0647	-0.0594	-0.0707	-0.0658
	(0.1064)	(0.1106)	(0.1060)	(0.1104)	(0.1105)	(0.1066)
export	-0.0558	-0.0741	-0.0656	-0.0563	-0.0622	-0.0633
	(0.0633)	(0.0625)	(0.0617)	(0.0640)	(0.0644)	(0.0630)
GDP per capita	-0.1589	-0.3768***	-0.4978***	-0.2964*	-0.1660	-0.4089***
	(0.1771)	(0.1229)	(0.1362)	(0.1672)	(0.1599)	(0.1456)
GDP growth	0.0333***	0.0218***	0.0138**	0.0433***	0.0343***	0.0709***
	(0.0093)	(0.0047)	(0.0059)	(0.0096)	(0.0079)	(0.0143)
inflation	0.0079*	0.0119**	0.0149***	0.0068	0.0066	0.0305***
	(0.0044)	(0.0047)	(0.0051)	(0.0047)	(0.0041)	(0.0089)
population	0.5833***	0.6761***	0.6251***	0.7885***	0.6085***	-0.2214
	(0.1298)	(0.1213)	(0.1224)	(0.1597)	(0.1137)	(0.2596)
urban share	-0.0209	-0.0065	0.0026	-0.0171	-0.0199	0.0634***
	(0.0139)	(0.0092)	(0.0102)	(0.0133)	(0.0125)	(0.0240)
N	2786	2786	2786	2786	2786	2786
pseudo R-sq	0.1089	0.1107	0.1121	0.1092	0.1092	0.1114

Note: The regressions are run with ordered probit, which is based on standard maximum likelihood estimation. The dependent variable "Corruption" is based on answers to the question - Do firms like yours typically need to make extra, unofficial payments to service providers to get connected to telephone? (1 = never, 2 = seldom, sometimes, frequently, mostly and 3 = always). Regressions include six dummies for firm size based upon employment and five dummies based upon sector of operations - manufacturing; agriculture, construction, service, and other. High Fee =1 if the tariff level is above the medium of the overall sample, and 0, otherwise. All the other variables are defined in Appendix Table 1. Standard errors are Huber-White standard errors allowing firms' error terms within country to be correlated for regressions. i.e., clustered errors at the country level. * significant at 10% level; ** significant at 5% level; *** significant at 1% level.

5. Conclusions

Using the World Bank datasets (WBES and EECAS) covering enterprise-level data on bribes paid to telecom utilities, and a unique cross country telecom regulation dataset collected by Wallsten et al. (2004), this paper examines how government regulation affects corporate corruption in the telecom sector. We find strong evidence that both regulatory substance and regulatory governance reduce corruption. In addition, we find that competition has positive effects on corruption control but state-owned telecoms have negative effects on corruption reduction; the effects of regulatory substance on corruption control are stronger in countries with more competition, state-owned or partially state-owned telecoms and higher telecom fees; finally, government effectiveness exert substitution effects to regulatory substance in deterring corruption.

Many empirical studies do not incorporate regulatory substance effects due to the difficulty of obtaining comparable data on policies. This study provides a starting point for evaluating the regulatory substance effects on corruption. The research both constructs and utilizes an index based on information on tariff setting, accountants' ratio, quality of service standards, and periodic reviews. Future research could enhance this index by incorporating more comprehensive indicators of the accounting system. Furthermore, an evaluation of how each component of a regulatory system affects sector outcomes would also be interesting.

If new national regulatory systems cannot promote good outcomes within infrastructure sectors, the agencies will lose political legitimacy and investor credibility; their efficacy will be called into question. Therefore, the ultimate goal for policymakers is not a specific set of institutional features, but a sustainable system which can convince investors (both equity owners and bond-holders) that service providers have the opportunity to earn profits on investments (commensurate with risks) and also assure consumers that the industry is providing service improvements at affordable prices. Processes that increase transparency and citizen participation are more likely to address

perceived problems (like bribery) than regulatory agencies which lack professionalism or are not interested in promoting citizens' confidence in the entire governance system.

References

Ai, Chunrong and Sappington, David E.M., 2005. Reviewing the impact of incentive regulation on U.S. telephone service quality. Utilities Policy 13, 201-210.

Aidt, Toke, Dutta, Jayasri, Sena, Vania, 2008. Governance regimes, corruption and growth: Theory and evidence. Journal of Comparative Economics 36, 195-220.

Anbarci, Nejat, Escaleras, Monica, Register, Charles A., 2009. The ill effects of public sector corruption in the water and sanitation sector. Land Economics 85, 363-377.

Barth, James R., Lin, Chen, Lin, Ping, Song, Frank M., 2009. Corruption in bank lending to firms: Cross-country micro evidence on the beneficial role of competition and information sharing. Journal of Financial Economics 91, 361-388.

Beck, Thorsten, Demirgüç-Kunt, Asli, Levine, Ross, 2006. Bank supervision and corruption in lending. Journal of Monetary Economics 53, 2131-2163.

Beck, Thorsten, Demirgüç-Kunt, Asli, Levine, Ross, 2003. Law, endowments, and finance. Journal of Financial Economics 70, 137-181.

Berg, Sanford V., Lin, Chen, Tsaplin, Valeriy, 2005. Regulation of state-owned and privatized utilities: Ukraine electricity distribution company performance. Journal of Regulatory Economics 28, 259–287.

Bose, Niloy, Capasso, Salvatore, Murshid, Antu Panini, 2008. Threshold effects of corruption: Theory and evidence. World Development 36, 1173-1191.

Brown, Ashley C., Stern, Jon, Tenenbaum, Bernard, Gencer, Defne, 2006. Handbook for Evaluating Infrastructure Regulatory Systems, the World Bank, Washington, D.C., pp. 5.

Cai, Hongbin, Fang, Hanming, Xu, Lixin Colin, 2011. Eat, drink, firms, government: An investigation of corruption from entertainment and travel costs of Chinese firms. Journal of Law and Economics 54, 55-78.

Clarke, George R.G. and Xu, Lixin Colin, 2004. Privatization, competition, and corruption: how characteristics of bribe takers and payers affect bribes to utilities. Journal of Public Economics 88, 2067-2097.

Dal Bó, Ernesto, Rossi, Martín A., 2007. Corruption and inefficiency: Theory and evidence from electricity utilities. Journal of Public Economics 91, 939-962.

Djankov, Simeon, La Porta, Rafael, López-de-Silanes, Florencio, Shleifer, Andrei, 2002. The regulation of entry. Quarterly Journal of Economics 117, 1-37.

Dreher, Axel, Kotsogiannis, Christos, McCorriston, Steve, 2007. Corruption around the world: Evidence from a structural model. Journal of Comparative Economics 35, 443-466.

Easterly, William, Levine, Ross, 1997. Africa's growth tragedy: policies and ethnic divisions. Quarterly Journal of Economics 112, 1203-1250.

Emerson, Patrick M., 2006. Corruption, competition and democracy. Journal of Development Economics 81, 193–212.

Estache, Antonio, Goicoechea, Ana, Trujillo, Lourdes, 2009. Utilities reforms and corruption in developing countries. Utilities Policy 17, 191-202.

Estache, Antonio, Wren-Lewis, Liam, 2011. Anti-corruption policies in theories of sector regulation. In: Rose-Ackerman, Susan, Søreide, Tina, (Eds.), The International Handbook of Anti-Corruption Economics, Vol. 2, Chapter 9, Northampton, USA and Cheltenham, UK: Edward Elgar Publishing.

Fan, Simon C., Lin, Chen, Treisman, Daniel, 2009. Political decentralization and corruption: evidence from around the world. Journal of Public Economics, 93, 14-34.

Gasmi, Farid, Recuero Virto, Laura, 2010. The determinants and impact of telecommunications reforms in developing countries. Journal of Development Economics 93, 275-286.

Gutièrrez, Luis H., 2003. The effect of endogenous regulation on telecommunications expansion and efficiency in Latin America. Journal of Regulatory Economics 23, 257-286.

Houston, Joel. Lin, Chen, Ma, Yue, 2011. Media ownership, concentration and corruption in bank lending. Journal of Financial Economics 100, 326-350.

Kalt, Joseph P., Zupan, Mark A., 1984. Capture and ideology in the economic theory of politics. American Economic Review 74, 279-300.

Kaufmann, Daniel, Kraay, Aart, Mastruzzi, Massimo, 2006. Governance matters V: Aggregate and individual governance indicators. World Bank Policy Research Working Paper No. 4012.

Kenny, Charles, 2009. Is there an anticorruption agenda in utilities? Utilities Policy 17, 156-165.

Laffont, Jean-Jacques, Tirole, Jean, 1991. The politics of government decision-making: A theory of regulatory capture. The Quarterly Journal of Economics 106, 1089-127.

Laffont, Jean-Jacques, Tirole, Jean, 1993. A theory of incentives in procurement and regulation, Cambridge, Mass; London: MIT Press.

Laffont, Jean-Jacques, 2005. Regulation and Development, Cambridge and New York: Cambridge University Press.

Levy, Brian, Spiller, Pablo T., 1994. The institutional foundations of regulatory commitment: A comparative analysis of telecommunications regulation. Journal of Law, Economics and Organization 10, 201-246.

Levy, Brian, Spiller, Pablo T., 1996. Regulations, Institutions, and Commitment: Comparative Studies of Telecommunications. Cambridge: Cambridge University Press.

Li, Wei, Xu, Lixin Colin, 2002. The political economy of privatization and competition: cross-country evidence from the telecommunications sector. Journal of Comparative Economics 30, 439-462.

Li, Wei, Xu, Lixin Colin, 2004. Liberalization and performance in the telecommunications sector around the world. Journal of Law & Economics 47, 395-430.

Martimort, David, Straub, Stéphane, 2009. Infrastructure privatization and changes in corruption patterns: The roots of public discontent. Journal of Development Economics 90, 69-84.

Peltzman, Sam, 1976. Toward a more general theory of regulation. Journal of Law and Economics 19, 211-240.

Röller, Lars-Hendrik, Waverman, Leonard, 2001. Telecommunications infrastructure and economic development: A simultaneous approach. American Economic Review 91, 909-923.

Seim, Line T., Soreide, Tina, 2009. Bureaucratic complexity and impacts of corruption in utilities. Utilities Policy 17, 176-184.

Shleifer, Andrei, Vishny, Robert W, 1993. Corruption. Quarterly Journal of Economics 108, 599-617.

Stern, Jon, 1994. Economic regulation in central and eastern Europe. Economics of Transition 2, 391-398.

Stern, Jon, Holder, Stuart, 1999. Criteria for assessing the performance of regulatory systems. Utilities Policy 8, 33-50.

Stigler, George J., 1971. The Theory of Economic Regulation. Bell Journal of Economics 2, 3-21.

Svensson, Jakob, 2003. Who must pay bribes and how much? Evidence from a cross-section of firms. Quarterly Journal of Economics 118, 207-230.

Treisman, Daniel, 2000. The causes of corruption: a cross-national study. Journal of Public Economics 76, 399-457.

Vagliasindi, Maria, 2011. “Public versus private governance and performance: Evidence from public utility service provision”. In: Rose-Ackerman, Susan, Søreide, Tina, (Eds.), The International Handbook of Anti-Corruption Economics, Vol. 2, Chapter 6, Northampton, USA and Cheltenham, UK: Edward Elgar Publishing.

Wallsten, Scott, Clarke, George, Haggarty, Luke, Kaneshiro, Rosario, Noll, Roger, Shirley, Mary, Xu, Colin Lixin, 2004. New Tools for Studying Network Industry Reforms in Developing Countries: The Telecommunications and Electricity Regulation Database. Review of Network Economics 3, 248-282.

Appendix Table 1. Variable Description and Sources

Variable	Name	Definition	Original Source
Frequencies of bribery	corruption	Frequency of payments to telephone authorities 1=never 2=seldom, sometimes, frequently, or mostly, 3=always	World Business Environment Survey (WBES)
Regulatory governance index	regulatory governance	(G1+G2+G3+G4)/4	Calculated
	independence	a0*(a1+a2+a3)/3=G1	Calculated
		a0=1 if the regulatory agency is separated from the utility and from the communications ministry started work; =0 otherwise.	World Bank Telecommunications Regulation Survey (2001)
		a1=1 if the regulator's budget all comes from license fees or donors' contributions; =0 if from the government budget; =0.5 if from both types of sources.	
		a2 =1 if the minister or president cannot veto the regulator's decision; =0 if otherwise.	
		a3 =1 if the minister or president has not written policy guidelines during the past year; =0 if otherwise.	
	clarity of roles	(b1+b2+b3+b4+b5)/5=G2	Calculated
		b1=1 if the regulator approves fixed-line local telephone prices; =0 if otherwise.	World Bank Telecommunications Regulation Survey (2001)
		b2=1 if the regulator grants licenses in fixed-line local telephony; =0 if otherwise.	
		b3=1 if the regulator can decide how many licenses will be issued; =0 if otherwise.	
		b4=1 if the regulator can assign spectrum use; =0 if otherwise.	
		b5=1 if the regulator is in charge of resolving conflicts when two operators cannot agree on interconnection/access terms; =0 if otherwise.	
	accountability	(d1+d2)/2=G3	Calculated
		d1=1 if the operator can appeal to the regulator when disagrees with regulators	World Bank

Appendix Table 1. Variable Description and Sources

Variable	Name	Definition	Original Source
		decision; =0 if otherwise.	Telecommunications Regulation Survey (2001)
		d2=1 if the other parties can appeal to the regulator when disagrees with regulators decision; =0 if otherwise.	
	transparency and participation	(c1+c2+c3+c4)/4=G4	Calculated
		c1=1 if all regulatory meetings open to the public in practice; =0 if otherwise.	World Bank Telecommunications Regulation Survey (2001)
		c2=1 if regulatory decisions are publicly available; =0 if otherwise.	
		c3=1 if regulator publish decisions in practice; =0 if otherwise. c4=1 if regulator publish explanations of decisions in practice; =0 if otherwise.	
Regulatory substance index	regulatory substance	(S1+S2+S3+S4)/4	Calculated
	tariff setting	(h1+h2+h3+h4+h5)/5=S1	Calculated
		h1=1 if the fixed-line local telephony prices are regulated; =0 if otherwise.	World Bank Telecommunications Regulation Survey (2001)
		h2=1 if the cellular telephony prices are regulated; =0 if otherwise.	
		h3=1 if the domestic long-distance telephony prices are regulated; =0 if otherwise.	
		h4=1 if the international long-distance telephony prices are regulated; =0 if otherwise.	
		h5=1 if the internet service providers telephony prices are regulated; =0 if otherwise.	
	quality standards setting	(j1+j2+j3+j4+j5)/5=S2	Calculated
		j1=1 if the law requires that all entrants receive the same technical terms and conditions for access/interconnection; =0 if otherwise.	World Bank Telecommunications Regulation Survey (2001)
		j2=1 if the law requires that all entrants receive the same prices for	

Appendix Table 1. Variable Description and Sources

Variable	Name	Definition	Original Source
		access/interconnection; =0 if otherwise. j3=1 if the regulator actually collects the performance indicator for call completion rates by operator; =0 if otherwise. j4=1 if the regulator actually collects the performance indicator for faults/faults repair; =0 if otherwise. j5=1 if the regulator actually collects the performance indicator for geographical coverage rates; =0 if otherwise.	
	accountants ratio	S3 = the number of accountants divided by the telecommunications industry's total revenue, and standardized to the country with the highest ratio.	Calculated
	periodic review	S4=1 there is a set period of time between regulator reviews; =0 if otherwise.	World Bank Telecommunications Regulation Survey (2001)
Tariff level	fee	=(subscription fee + connection fee)/2	Calculated
	subscription fee	12*monthly subscription fee/GDP per capita	Calculated from ITU Statistical Year Book 2002
	connection fee	12*connection fee/GDP per capita	
Competition	competition	The logarithm of number of operators	World Telecommunication Regulatory Database published annually on ITU website
State-owned	state-owned	=1 if fixed line telecommunications operators are wholly state-owned; =0 if othersies.	Idem
	partially_state_owned	=1 if fixed line telecommunications operators are partially state-owned; =0 if otherwise.	Idem
	fully privatized	=1 if fixed line telecommunications operators are fully privatized; =0 otherwise.	Idem

Appendix Table 1. Variable Description and Sources

Variable	Name	Definition	Original Source
Firm-level Control Variables:			
Ownership	government	= percentage of government ownership.	WBES
	foreign	=percentage of foreign ownership.	Idem
Firm Size	smallest	=1 if fewer than 9 employees; =0 if otherwise.	Idem
	small	=1 if between 10 and 49 employees; =0 if otherwise.	
	medium	=1 if between 50 and 99 employees; =0 if otherwise.	
	large	=1 if between 100 and 249 employees; =0 if otherwise.	
	largest	=1 if between 250 and 499 employees; =0 if otherwise. The omitted variable is the dummy variable=1 if there are more than 500 employees and 0 otherwise.	
Exports	export	1=yes 0=no	Idem
Sector	manufacturing	1=yes 0=no	Idem
	service	1=yes 0=no	Idem
	agriculture	1=yes 0=no	Idem
	construction	1=yes 0=no	Idem
Country-level Control Variables:			
GDP per capita	GDP per capita	GDP per capita in PPP adjusted international dollars, averaged over 1995-1999	World development indicators from IMF
GDP growth	GDP growth	Growth rate of GDP, averaged over 1995-1999	Idem
Inflation	inflation	Average between 1995-1999	International financial statistics (IFS)
Population	population	The natural logarithm of total population	World Development Indicators & Global Development Finance from the World Bank

Appendix Table 1. Variable Description and Sources

Variable	Name	Definition	Original Source
Urban Share	urban share	Urban population as a percentage of total population.	World Development Indicators & Global Development Finance from the World Bank
Other Macro Control Variables:			
Fuel, ores, and metal exports	fuel_ores_metal	["Fuel exports (% of merchandise exports)" + "Ores and metals exports (% of merchandise exports)"] * ["Merchandise Exports (current price)"/ GDP (current price)]	World Bank
Democracy index	democracy	An index with a range from 1 to 7. Calculated by taking the average of LIEC & EIEC. The high the index means greater level of democracy.	Thorsten Beck, George Clarke, Alberto Groff, Philip Keefer, and Patrick Walsh, 2001. "New tools in comparative political economy: The Database of Political Institutions." 15:1, 165-176 (September), World Bank Economic Review.
Government expenditure	government expenditure	The Government Expenditure as a % of GDP	World Bank
Political right	political right	Index between 1 and 7 with higher values indicating greater democracy	Freedom House (2000)

Appendix Table 1. Variable Description and Sources

Variable	Name	Definition	Original Source
Institutional Variables			
-- Country-specific variables that are used as Control Variables:[26]			
Voice and accountability	voice and accountability	Measuring the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.	The Worldwide Governance Indicators (WGI) project
Political stability and absence of violence	political stability	Measuring perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including domestic violence and terrorism	Idem
Government effectiveness	government effectiveness	Measuring the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies	Idem
Regulatory quality	regulation quality	Measuring the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development	Idem
Control of corruption	control of corruption	Measuring the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests	Idem
Rule of law	rule of low	Measuring the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence	Idem
Instrumental Variables			
Geographic Location	abs_latitude	Logarithm of absolute value of latitude	Vikipedia.com
Policy Suppliers	ideology	Following Li and Xu (2002), this variable is constructed as an index of principal components indicating the ideological inclination of legislature, lagged one year.	World Bank Database of Political Institutions, DPI2010.
	party polarization	The maximum difference in orientation measures (Left=-1, Center=0, Right=1) between the chief executive's party's value and the values of the three largest	Idem

[26] Definition for the country governance indicator measurement is directly from Melissa Thomas, "What do the worldwide governance indicators measure?" 2007, SSRN working paper: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1007527

Appendix Table 1. Variable Description and Sources

Variable	Name	Definition	Original Source
		government parties and the largest opposition party. The minimum is 0, and the maximum is 2.	
	balances_and_checks	Following Li and Xu (2002), this variable is constructed as the logarithm of the number of veto players, ranges from 1 to 4.	Idem
Financial Depth	financial depth	Following Li and Xu (2002), this variable is constructed as an index of principal components of three variables, M2/GDP, stock market capitalization/GDP, and bank assets/GDP. Each component variable is standardized to have mean o and variance 1.	World Development Indicators & Global Development Finance from the World Bank

Appendix Table 2. OLS Regression: Determinants of Corporate Corruption

	(1)	(2)	(3)	(4)	(5)
regulatory substance	-0.5354***	-0.5718**		-1.9291***	
	(0.1367)	(0.2671)		(0.6079)	
regulatory governance			-0.6004**	-0.7427***	
			(0.2385)	(0.1771)	
regulation					-2.0406***
					(0.4524)
fee	0.2618***	0.1401*	0.1513***	0.3806***	0.2727***
	(0.0403)	(0.0718)	(0.0467)	(0.0986)	(0.0597)
competition	-0.1102	-0.2389*	-0.3106***	-0.7817***	-0.5967***
	(0.0704)	(0.1347)	(0.0508)	(0.1749)	(0.1068)
state_owned	0.3826***	0.2436***	0.3357***	0.4169***	0.4167***
	(0.0857)	(0.0839)	(0.1254)	(0.1094)	(0.1160)
partially_state_owned	0.2128**	0.2083*	0.0162	0.1781**	0.0804
	(0.0920)	(0.1106)	(0.0744)	(0.0850)	(0.0577)
government	-0.3091***	-0.3056***	-0.2774***	-0.2741***	-0.2750***
	(0.0352)	(0.0339)	(0.0340)	(0.0331)	(0.0334)
foreign	-0.0982**	-0.0930**	-0.0542	-0.0338	-0.0442
	(0.0427)	(0.0431)	(0.0472)	(0.0469)	(0.0467)
export	-0.0449*	-0.0422	-0.0308	-0.0209	-0.0281
	(0.0262)	(0.0255)	(0.0276)	(0.0284)	(0.0274)
GDP per capita		-0.1153**	-0.2214***	-0.0106	-0.1486***
		(0.0456)	(0.0358)	(0.0669)	(0.0234)
GDP growth		0.0010	0.0120***	0.0195***	0.0174***
		(0.0061)	(0.0025)	(0.0039)	(0.0034)
inflation		0.0005	0.0063***	0.0048**	0.0074***
		(0.0026)	(0.0021)	(0.0021)	(0.0023)
population		0.0833	0.1451***	0.2887***	0.2196***
		(0.0532)	(0.0286)	(0.0574)	(0.0334)
urban share		-0.0018	0.0045*	-0.0148***	-0.0035**
		(0.0040)	(0.0026)	(0.0053)	(0.0016)
Industry Dummies	Yes	Yes	Yes	Yes	Yes
Firm Size Dummies	Yes	Yes	Yes	Yes	Yes
N	3731	3731	2786	2786	2786
R-sq	0.1774	0.2146	0.2108	0.2190	0.2165

Note: The regressions are run based on ordinary least square estimation (OLS). The dependent variable "Corruption" is based on answers to the question - Do firms like yours typically need to make extra, unofficial payments to service providers to get connected to telephone? (1 = never, 2 = seldom, sometimes, frequently, mostly and 3 = always). Regressions include six dummies for firm size based upon employment and five dummies based upon sector of operations - manufacturing; agriculture, construction, service, and other. All the other variables are defined in Appendix Table 1. Standard errors are in parentheses. Standard errors are Huber-White standard errors allowing firms' error terms within country to be correlated for regressions. i.e., clustered errors at the country level. * significant at 10% level; ** significant at 5% level; *** significant at 1% level.